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10/510,479	10/07/2004	Seitaro Matsuo	T0203.0008/P0008	7443

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DICKSTEIN SHAPIRO LLP
1825 EYE STREET NW
Washington, DC 20006-5403

EXAMINER	
DHINGRA, RAKESH KUMAR	
ART UNIT	PAPER NUMBER
1792	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/510,479	MATSUO ET AL.	
	Examiner	Art Unit	
	RAKESH K. DHINGRA	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *03* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 December 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *7-13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *7-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 October 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/14/07 has been entered.

Claim Objections

Claim 7 is objected to because of the following informalities:

Line 8 – "from microwave transmitting means" may be corrected to "from a microwave transmitting means";

Line 22 – "a first opening" may be replaced by "the first opening", since the first opening is already recited in line 17.

Appropriate correction is required.

Response to Arguments

Applicant's arguments with respect to claims 7-13 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended independent claim 7 by adding new limitations "which is terminated on one end portion of the straight shape microwave cavity resonator with a metal plate to form a terminal end portion having no opening, the other end portion of the straight shape microwave cavity resonator having a first opening formed by inserting a metal plate slit into the other end portion, the straight shape microwave cavity resonator being disposed between a microwave source and the plasma generating

member"; and "two or more second resonance units being disposed in the straight shape microwave cavity resonator".

Claims 7-13 are currently pending and active.

New references [Kamide (US 5,306,379), Kamarehi et al (US 5,961,851) and Dandl (US Patent No. 5,975,014] when combined with Kou et al read on amended claim 7 limitations. Accordingly claim 7 has been rejected under 35 USC 103 (a) as explained below. Further, remaining claims 8-13 have also been rejected under 35 USC 103 (a) as explained below.

Regarding applicant's argument that in Kou reference, the structure is incapable of using only the in-phase microwaves for generating plasma, since microwaves excites the resonant mode of the pi. mode and the adjacent cavity is deemed to resonate with the microwaves in the opposite phase, examiner responds that Kou is used since it teaches claim limitation pertaining to cavity having metal plate at one end and another metal plate at the second end with a slit. Limitation pertaining to openings in resonant units is taught by Dandl as explained below.

Responding to applicant's further argument that in Kou the disclosed resonator acts to increase amplitude of surface wave by bringing into resonance with the surface wave generated from the dielectric plate an opening would obstruct the purpose that surface wave is increased by resonance, examiner responds that as explained below, Dandl teach that geometry and location of stubs is optimized to ensure that microwaves in phase are emitted from the openings. Thus Kamide in view of Kou, Kamarehi and Dandl teach all limitations of claim 7 as explained below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter

> sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kamide (US 5,306,379) in view of Kou et al (US Patent No. 6,246,175), Kamarehi et al (US 5,961,851) and Dandl (US 5,975,014).

Regarding Claim 7: Kamide et al teach an ECR plasma source comprising:

a rectangular plasma generation chamber 31 with a rectangular opening for processing a rectangular substrate 71;

rectangular shaped electro-magnetic coils 18a, 18b for generating static magnetic field in the plasma chamber;

microwave introducing means that include straight shaped cavity resonator 38 for introducing microwaves through transmitting window 36 into the chamber 31; and

the microwave cavity 38 is disposed between a microwave source 40 and the plasma chamber 31 (e.g. Fig. 3 and col. 5, line 1 to col. 6, line 35).

Kamide teach the microwave introducing means includes a straight shaped cavity resonator but do not teach the same is terminated on one end portion with a metal plate to form a terminal end portion

having no opening, the other end portion of the straight shape microwave cavity resonator having a first opening formed by inserting a metal plate slit into the other end portion, and

between a terminal end portion having no opening and an end portion having a first opening disposed at a distance of n x (lambda.g/2) (n: an integer of 3 or more) from the terminal end portion, and in the side of the straight shape microwave cavity resonator, first resonance units having a length lambda.g (lambda.g: guide wavelength), but not having openings in a side, and second resonance units having a length of lambda.g (lambda.g: guide wavelength) and having at least one second opening in a side, are alternately arranged sequentially from the terminal end portion, two or more second resonance units being disposed in the straight shaped microwave cavity resonator so that microwaves in phase are introduced through the second opening into the plasma chamber.

However cavity resonator provided with a metal plate at one terminal end and a metal plate with a slit at the other end is known in the art as per reference cited hereunder.

Kou et al teach a plasma apparatus (Figures 1, 2, 5, 6) comprising a rectangular processing chamber 60 and a straight shaped adjustable cavity resonator 100 with a metal plate so as to form a terminal end portion having no opening, the other terminal end having a first opening 12 in a metal plate 11. Kou et al further teach that distance between a terminal end of the cavity and the other end having first opening 12 is a design parameter and is set such that cavity 100 can be configured as a resonant cavity. Kou et al further teach that cavity resonator 100 has plurality of vertical vanes 20 separated by interval strips 30 and the distance L) between is a period between the vanes which is one of the design parameters that is optimized (result effective variable) to obtain desired microwave electromagnetic field distribution. Kou et al further teach that distance between a terminal end of the cavity and the end having first opening is: 49 X 11 = 539 mm or 53.9 cm, where period L = 49 mm, which includes the range given in the claim formula (that is, lambda .sub.g /2 * n, where n is 3 or more and lambda .sub.g is approx. 12.24 cm for frequency of 2.45 GHz). It would be obvious to optimize the distance between a terminal

end of the cavity and the other end having a first opening (as a result effective variable) as per related process parameters like including resonant frequency of microwaves (col. 3, line 10 to col. 6, line 50).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use straight shaped microwave cavity resonator with first end having no opening and the second end with a slit, and optimize the distance between first and second ends as taught by Kou et al in the apparatus of Kamide to obtain desired microwave electromagnetic field distribution for processing large area substrates (column 2, lines 20-35).

Kamide in view of Kou et al do not teach in the side of straight shape microwave cavity resonator, first resonance units having a length lambda.g (lambda.g: guide wavelength), but not having openings in a side, and second resonance units having a length of lambda.g (lambda.g: guide wavelength) and having at least one second opening in a side, are alternately arranged sequentially from the terminal end portion a plurality of open areas each having at least one second opening are disposed at an interval corresponding to the guide wavelength lambda.g of the standing waves of the microwaves, so that microwaves in-phase are introduced through the second opening into the plasma chamber.

Kamarehi et al teach a plasma apparatus comprising a microwave cavity 42 that is partitioned into plurality of smaller sections 44, 45, 46 (similar to resonance units) so that each section functions like a short cavity and enables to obtain more uniform distribution of microwaves (e.g. Fig. 3 and col. 2, line 55 to col. 3, line 35).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide a plurality of resonance units in the cavity resonator as taught by Kamarehi et al in the apparatus of Kamide et al in view of Kou et al to obtain more uniform distribution of microwaves in the plasma chamber for large sized substrates.

Kamide in view of Kou et al and Kamarehi et al teach a staright shaped cavity resonator with plurality of resonance units, but do not teach in the side of straight shape microwave cavity resonator, first

resonance units having a length lambda.g (lambda.g: guide wavelength), but not having openings in a side, and second resonance units having a length of lambda.g (lambda.g: guide wavelength) and having at least one second opening in a side, are alternately arranged sequentially from the terminal end portion a plurality of open areas each having at least one second opening are disposed at an interval corresponding to the guide wavelength lambda.g of the standing waves of the microwaves, so that microwaves in-phase are introduced through the second opening into the plasma chamber.

Dandl teaches an ECR microwave plasma applicator (Figures 2; 3, 8A, 8B) comprising of a resonant coaxial structure 66 having plurality of slots (openings) 63B and a plurality of transverse radiating stubs 62T in an array 60 of the form shown, and having properly chosen size and spacing, and with a suitable termination to obtain a resonant antenna structure suitable for use as a distributed microwave applicator 12. Dandl further teaches that the transverse radiating stubs 62T will radiate in phase if stubs 62T with alternating polarity are spaced at half-wavelength intervals along the coaxial transmission line 66 and the structure launches electromagnetic fields in the form of coherent plane waves (e.g. Fig. 2, 8A, 8B and col. 11, lines 5-35). It would be obvious to provide suitably optimized radiating stubs for size and spacing (as resonance units) as per teaching of Dandl in the apparatus of Kamide in view of Kou et al and Kamarehi et al to obtain in-phase microwaves radiating through slots and into the plasma chamber (claim does not recite any specific structure for the first and second resonance units except openings).

Therefore it would have been obvious to one of skills in the art at the time of the invention to provide first and second resonance units with optimized sizxe and spacing as taught by Dandl in the apparatus of Kamide in view of Kou et al and Kamarehi et al to obtain in-phase microwaves radiating through slots and into the plasma chamber.

In this connection courts have ruled (Case law):

It is well settled that determination of optimum values of cause effective variables such as these process parameters is within the skill of one practicing in the art. *In re Boesch*, 205 USPQ 215 (CCPA 1980).

Claims 8, 9, 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kamide (US 5,306,379) in view of Kou et al (US Patent No. 6,246,175), Kamarehi et al (US 5,961,851) and Dandl (US 5,975,014) as applied to Claim 7 and further in view of Hiroshi et al (US Patent No. 5,389,154).

Regarding Claim 8: Kamide in view of Kou et al, Kamarehi et al and Dandl et al teach all limitations of the claim except that microwave introducing means includes microwave branching means.

Hiroshi et al teach an ECR plasma apparatus (Figure 1) comprising:

a plasma generation chamber 20, magnetic coils 50, waveguide 33 with dividing circuit 64 (microwave branching means comprising of microwave branching portion 37 – page 16, lines 15-25 of the specification) [column 6, lines 40-60].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use microwave introducing means which include branching and binding means as taught by Hiroshi et al in the apparatus of Kamide in view of Kou et al, Kamarehi et al and Dandl et al to enable control formation of node and the phase of the magnetic fields of microwaves (column 7, lines 15-50).

Regarding Claims 9, 11: Hiroshi et al teach that apparatus is an ECR plasma apparatus.

Claims 10, 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kamide (US 5,306,379) in view of Kou et al (US Patent No. 6,246,175), Kamarehi et al (US 5,961,851) and Dandl (US Patent No. 5,975,014) as applied to Claims 9, 11 and further in view of Dotter et al (US Patent No. 6,463,874).

Regarding Claims 10, 12: Kamide in view of Kou et al, Kamarehi et al and Dandl teach all limitations of the claim except sample moving means.

Dotter et al teach a linear plasma applicator 250 having a plurality of openings 253-258 disposed at a distance of lambda (similar to first and second resonance units with and without openings respectively, and disposed sequentially at a distance of lambda/2) to prevent the microwaves from cancelling each other, that is, the microwaves reinforce each other or being in-phase. Dotter et al further teach that geometry and spacing of openings is optimized to achieve a uniform microwave field within the plasma chamber. It would be obvious to optimize the geometry and location of of openings in the cavity resonator as per teaching of Dotter et al in the apparatus of Kamide in view of Kou et al and Kamarehi to obtain uniform microwave field in the plasma chamber to enable process large sized substrates with improved uniformity. Dotter et al also teach that substrate 30 can be fixed or moved by moving means between deposition stations 70, 80 respectively (e,g. Figs. 2, 6, 7 and col. 13, lines 1-65).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide substrate moving means as taught by Dotter et al in the apparatus of Kamide in view of Kou et al, Kamarehi et al and Dandl to enable process large sized substrates with improved uniformity.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kamide (US 5,306,379) in view of Kou et al (US Patent No. 6,246,175), Kamarehi et al (US 5,961,851) and Dandl (US 5,975,014) as applied to Claim 7 and further in view of Goulouev (US Patent No. 6,169,466).

Regarding Claim 13: Kamide in view of Kou et al, Kamarehi et al and Dandl teach all limitations of the claim except opening between first and second resonance units.

Goulouev teach a waveguide (Figure 1) with plurality of resonator cavities 16A (resonator units) 16A and having a microwave channel 15 (opening) between successive resonator units (Figure 15) [column 4, lines 1-22].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to provide an opening between first and second resonator units as taught by Goulouev in the

apparatus of Kamide in view of Kou et al, Kamarehi et al and Dandl to provide a path for electromagnetic energy to flow through the waveguide.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH K. DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Rakesh K Dhingra/
Examiner, Art Unit 1792

/Karla Moore/
Primary Examiner, Art Unit 1792